CLAIMS

1. An ink jet printhead comprising:
a structure being less than 5 microns thick;
a plurality of nozzles incorporated on the structure; and
at least one respective heater element corresponding to each nozzle, wherein each element is arranged for being in thermal contact with a bubble forming liquid, and
each element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble therein thereby to cause the ejection of a drop of the bubble forming liquid through the nozzle corresponding to that element.

2. The printhead of claim 1 being configured to support the bubble forming liquid in thermal contact with each said element,.

3. The printhead of claim 1 being configured to print on a page and to be a page-width printhead.

4. The printhead of claim 1 wherein the structure is less than 2.5 microns thick.

5. The printhead of claim 1 wherein each heater element is in the form of a suspended beam having a pair of planar surfaces on opposite sides of the element, the element being suspended such that each of the planar surfaces is in thermal contact with the bubble forming liquid such that the bubble is formed at both of the element surfaces.

6. The printhead of claim 1 wherein each element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that element to heat that element sufficiently to form said bubble in the bubble forming liquid thereby to cause the ejection of a said drop.

7. The printhead of claim 1 configured to receive a supply of the bubble forming liquid at an ambient temperature, wherein each heater element is configured such that the energy

required to be applied thereto to heat said part to cause the ejection of said drop is less than the energy required to heat a volume of said bubble forming liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

8. The printhead of claim 1 comprising a substrate having a substrate surface, wherein each nozzle has a nozzle aperture opening through the substrate surface, and wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

9. The printhead of claim 1 wherein the bubble which each element is configured to form is collapsible and has a point of collapse, and wherein each element is configured such that the point of collapse of a bubble formed thereby is spaced from that element.

10. The printhead of claim 45 wherein the structure and the walls are integrally formed by chemical vapor deposition (CVD).

11. The printhead of claim 1 comprising a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the elements within each chamber being formed in different respective layers.

12. The printhead of claim 1 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one element having an atomic number below 50.

13. The printhead of claim 1 wherein each heater element includes solid material and has a mass of less than 10 nanograms of the solid material of that element to be heated to a temperature above the boiling point of the bubble forming liquid thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of a said drop.

14. The printhead of claim 1 wherein each element is substantially covered by a conformal protective coating, the coating of each element having been applied substantially to all sides of the element simultaneously such that the coating is seamless.

15. A printer system incorporating a printhead, the printhead comprising:
a structure being less than 5 microns thick;
a plurality of nozzles incorporated on the structure; and
at least one respective heater element corresponding to each nozzle, wherein each element is arranged for being in thermal contact with a bubble forming liquid, and
each element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble therein thereby to cause the ejection of a drop of the bubble forming liquid through the nozzle corresponding to that element.

16. The system of claim 15 being configured to support the bubble forming liquid in thermal contact with each said element.

17. The system of claim 15 being configured to print on a page and to be a page-width printhead.

18. The system of claim 15 wherein the structure is less than 2.5 microns thick.

19. The system of claim 15 wherein each heater element is in the form of a suspended beam having a pair of planar surfaces on opposite sides of the element, the element being suspended such that each of the planar surfaces is in thermal contact with the bubble forming liquid such that the bubble is formed at both of the element surfaces.

20. The system of claim 15 wherein each element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that element to heat that element sufficiently to form said bubble in the bubble forming liquid thereby to cause the ejection of said drop.

21. The system of claim 15, wherein the printhead is configured to receive a supply of the bubble forming liquid at an ambient temperature, and wherein each heater element is configured such that the energy required to be applied thereto to heat said part to cause the ejection of said drop is less than the energy required to heat a volume of said bubble forming liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

22. The system of claim 15 comprising a substrate having a substrate surface, wherein each nozzle has a nozzle aperture opening through the substrate surface, and wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

23. The system of claim 15 wherein the bubble which each element is configured to form is collapsible and has a point of collapse, and wherein each element is configured such that the point of collapse of a bubble formed thereby is spaced from that element.

24. The system of claim 46 wherein the structure and the walls are integrally formed by chemical vapor deposition (CVD).

25. The system of claim 15 comprising a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the elements within each chamber being formed in different respective layers.

26. The system of claim 15 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one element having an atomic number below 50.

27. The system of claim 15 wherein each heater element includes solid material and has a mass of less than 10 nanograms of the solid material of that element to be heated to a temperature above the boiling point of the bubble forming liquid thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of said drop.

28. The system of claim 15 wherein each element is substantially covered by a conformal protective coating, the coating of each element having been applied substantially to all sides of the element simultaneously such that the coating is seamless.

29. A method of ejecting a drop of a bubble forming liquid from a printhead, the printhead comprising a plurality of nozzles and at least one respective heater element corresponding to each nozzle, the method comprising the steps of:

providing the printhead, the printhead having a structure which is less than 5 microns thick and which incorporates said nozzles thereon;

heating at least one element corresponding to a said nozzle so as to heat at least part of the bubble forming liquid which is in thermal contact with the at least one heated element to a temperature above the boiling point of the bubble forming liquid;

generating a gas bubble in the bubble forming liquid by said step of heating; and

causing the drop of bubble forming liquid to be ejected through the nozzle corresponding to the at least one heated element by said step of generating a gas bubble.

30. The method of claim 29 comprising, before said step of heating, the steps of:

disposing the bubble forming liquid in thermal contact with the elements.

31. The method of claim 29 wherein, in the step of providing the printhead, the structure is less than 2.5 microns thick.

32. The method of claim 29 wherein each heater element is in the form of a suspended beam having a pair of planar surfaces on opposite sides of the element, the method further comprising, prior to the step of heating at least one element, the step of disposing the bubble forming liquid such that each of the planar surfaces of the elements are positioned in thermal contact with, at least a portion of the bubble forming liquid.

33. The method of claim 29 wherein the step of heating at least one element is effected by applying an actuation energy of less than 500nJ to each such element.

34. The method of claim 29, comprising, prior to the step of heating at least one heater element, the step of receiving a supply of the bubble forming liquid, at an ambient temperature, to the printhead, wherein the step of heating is effected by applying heat energy to each such heater element, wherein said applied heat energy is less than the energy required to heat a volume of said bubble forming liquid equal to the volume of said drop, from a temperature equal to said ambient temperature to said boiling point.

35. The method of claim 29 wherein, in the step of providing the printhead, the printhead includes a substrate having a substrate surface, and each nozzle has a nozzle aperture opening through the substrate surface wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

36. The method of claim 29 wherein, in the step of generating a gas bubble, the generated bubble is collapsible and has a point of collapse, and is generated such that the point of collapse is spaced from the at least one heated element.

37. The method of claim 47 wherein the step of providing the printhead includes integrally forming the structure and the walls by chemical vapor deposition (CVD).

38. The method of claim 29 wherein the printhead has a plurality of nozzle chambers, each chamber corresponding to a respective nozzle, and wherein the step of providing the printhead includes forming a plurality of said heater elements in each chamber, such that the elements in each chamber are formed in different respective layers to one another.

39. The method of claim 29 wherein, in the step of providing the printhead, each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one element having an atomic number below 50.

40. The method of claim 29 wherein each heater element includes solid material has a mass of less than 10 nanograms and wherein the step of heating at least one element includes heating the solid material of each such element to a temperature above said boiling point.

41. The method of claim 29 wherein the step of providing the printhead includes applying to each element, substantially to all sides thereof simultaneously, a conformal protective coating such that the coating is seamless.

42. The printhead of claim 9 wherein each nozzle defines an axis, the nozzle being disposed about the axis, the axis extending into the chamber, wherein the point of collapse is disposed on the axis and wherein the element is configured so that the element is spaced from the axis.

43. The system of claim 23 wherein each nozzle defines an axis, the nozzle being disposed about the axis, the axis extending into the chamber, wherein the point of collapse is disposed on the axis and wherein the element is configured so that the element is spaced from the axis.

44. The method of claim 36 wherein each nozzle defines an axis, the nozzle being disposed about the axis, the axis extending into the chamber and the element being spaced from the axis, and wherein, the gas bubble is generated such that the point of collapse is disposed on the axis.

45. An ink jet printhead comprising:

a structure being less than 10 microns thick;

a plurality of nozzles incorporated on the structure;

at least one wall corresponding to each nozzle, the at least one wall being integrally formed with, and extending from, the structure and forming a circumferential perimeter that together with the structure defines a chamber in communication with the respective nozzle for receiving a bubble forming liquid; and

at least one respective heater element corresponding to each nozzle, wherein

each element is arranged for being in thermal contact with the bubble forming liquid, and

each element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble therein thereby to cause the ejection of a drop of the bubble forming liquid through the nozzle corresponding to that element.

46. A printer system incorporating a printhead, the printhead comprising:

a structure being less than 10 microns thick;

a plurality of nozzles incorporated on the structure

at least one wall corresponding to each nozzle, the at least one wall being integrally formed with, and extending from, the structure and forming a circumferential perimeter that together with the structure defines a chamber in communication with the respective nozzle for receiving a bubble forming liquid; and

at least one respective heater element corresponding to each nozzle, wherein

each element is arranged for being in thermal contact with the bubble forming liquid, and

each element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble therein thereby to cause the ejection of a drop of the bubble forming liquid through the nozzle corresponding to that element.

47. A method of ejecting a drop of a bubble forming liquid from a printhead, the printhead comprising a structure being less than 10 microns thick;

a plurality of nozzles incorporated on the structure; at least one wall corresponding to each nozzle, the at least one wall being integrally formed with, and extending from, the structure and forming a circumferential perimeter that together with the structure defines a chamber in communication with the respective nozzle for receiving the bubble forming liquid; and at least one respective heater element corresponding to each nozzle, the method comprising the steps of:

providing the printhead;

heating at least one element corresponding to a said nozzle so as to heat at least part of a bubble forming liquid which is in thermal contact with the at least one heated element to a temperature above the boiling point of the bubble forming liquid;

generating a gas bubble in the bubble forming liquid by said step of heating; and

causing the drop of bubble forming liquid to be ejected through the nozzle corresponding to the at least one heated element by said step of generating a gas bubble.